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AUTHOR Ogden, William R.; Jackson, Janis L.
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ABSTRACT

Selected professional periodicals were searched for statements of objectives of secondary school biology teaching for six subperiods of the period 1918-1972. Statements of 18 objective types were classified as to frequency of occurrence, category, authorship, and year of publication. The categories of objectives were: knowledge, process, attitude, interest, and cultural awareness. Seven of the objective types were identified as most prevalent, although all of the 18 objective types were found in the literature of all six subperiods. (MLH)

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A CHRONOLOGICAL HISTORY OF SELECTED OBJECTIVES FOR THE TEACHING OF SECONDARY SCHOOL BIOLOGY IN THE UNITED STATES DURING THE 1918-1972 PERIOD, AS REFLECTED IN PERIODICAL LITERATURE

William R. Ogden
East Texas State University
Commerce, Texas 75428

and

Janis L. Jackson
McLennan Community College
Waco, Texas 76701

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Introduction

This study is a modified replication of a paper presented by the senior author (2) at the 1974 NARST meeting in Chicago. Whereas the earlier study was concerned with the objectives for teaching secondary school chemistry during the 1918-1972 period, the present work is concerned with biology. Although the procedures followed were the same in both studies, they are outlined as follows:

Problem

To prepare a chronological history of selected objectives for teaching biology in the high school of the United States during the period 1918-1972, as reflected in selected professional periodicals.

Procedure

Selection of Subperiods

The 1918-1972 period was divided into subperiods on the basis of selected events in the social, political, or educational history of the United States. In all cases some overlapping of subperiods was planned to allow for the gradual transformation characteristic of historical change.

1. Subperiod 1 (1918-1933). Subperiod 1 extends from 1918, the beginning date of the study, through 1933. The year 1933 was selected as the termination date because the effects of the depression were not expressly felt in education until the mid-1930's and in 1933 the Progressive Education Association (PEA) began its Eight Year Study.
2. Subperiod 2 (1932-1941). The second subperiod extends from 1932, and the election of Franklin D. Roosevelt as President, through 1941, when the United States entered World War II.
3. Superiod 3 (1939-1946). Superiod 3 spans the 1939-1946 years, and covers the duration of World War II.
4. Subperiod 4 (1945-1957). Subperiod 4 extends from 1945 through 1957. It begins with the "Prosser resolution" and the following period of "life adjustment education" and ends with the successful launching of Sputnik I by the Soviet Union in 1957.
5. Subperiod 5 (1954-1964). Subperiod 5 begins in 1954 with mounting criticism of "life adjustment education" and ends following 1964 and growing student unrest as exemplified by the riots at the University of California's Berkeley campus.

6. Subperiod 6 (1963-1972). Subperiod 6 includes the 1963-1972 years. It begins with a growing uneasiness over the first wave of post Sputnik science curriculum projects and ends following 1972, the final full year of United States involvement in Viet Nam and prior to the Watergate Hearings.

Selection of Literature to be Studied

All issues of the following periodicals were read in an attempt to locate articles concerned with objectives for teaching secondary school biology.

1. School Science and Mathematics (1918-1972)
2. Science Education and The General Science Quarterly (1918-1972)
3. The Science Teacher and The Illinois Chemistry Teacher (1934-1972)
4. The American Biology Teacher (1939-1972)
5. The Bulletin of the Atomic Scientists (1945-1972)
6. The Journal of Research in Science Teaching (1963-1972)

All issues of the periodicals selected were read for relevant articles. Those selected for re-reading were chosen on the basis of the following criteria:

1. It was an expression of opinion or the result of formal research activity.
2. It was concerned with biology teaching at the secondary level. Articles concerned with science teaching in general were included if they used examples from biology or used general examples of use in the teaching of biology. Articles involving specific examples from subjects other than biology were eliminated.
3. It was concerned with biology teaching and not some aspects of pure biology. Such "informational" articles were eliminated unless specific reference was made to the possible implications for teaching.
4. It was not a committee report or a critique of a committee report.
5. It was not an editorial or a letter to the editor.

Articles were abstracted as to their stated objectives and the information and ideas expressed were recorded on cards. Each card contained a standard bibliographic reference plus notes on the content of the article.

Classification of Statements

Following a pilot study involving a search of 10 volumes of School Science and Mathematics selected at random from the period to be studied, statements were first categorized as knowledge, process, attitude & interest, and cultural awareness. Statements were then placed in subclasses on the basis of similarities and differences, an activity which resulted in the establishment of 18 distinct objective types. During this phase of the investigation no attempt was made to duplicate exactly the wording of the original authors. The subclasses were, instead, based upon common ideas or areas of concern such as "scientific methods of thinking" or "the nature of science and scientists." Categories and subclasses are defined as follows:

1. Knowledge objectives as determined from the data are those advocating the attainment of factual or conceptual material for its own sake or for its functional value and those stressing knowledges and skills basic to the study of biology. Types of objectives typical of this category are:

a. "Specific topics in biology - statements advocating the study of specifics such as cell theory, genetics, or evolution.

b. "Major facts, principles, concepts, or fundamentals" - objectives of this type are less detailed than those relating to the study of "specific topics..." and usually involve more than one example.

c. "The applications of biology to daily life" - These objectives tend to call for the application of the concepts or fundamentals of biology to life situations and are specific in that examples are often provided.

d. "A fund of useful information" - These objectives, although similar to c, stress the accumulation of a body of knowledge--not its application.

e. "Study skills" - Objectives of this type tend to stress knowledges and skills necessary for the successful study of biology. They include use of proper nomenclature and vocabulary and study habits.

2. Process objectives are those conveying an understanding and use of the methods and techniques of science. Statements included advocated skills in critical thinking and in problem solving as well as in the "processes" of observing, classifying, inferring, predicting, measuring communicating, interpreting data, making operational definitions, formulating questions and hypotheses, experimenting, formulating models (3).

f. "Scientific methods of thinking" - These objectives deal with thinking skills and methods of thinking as outcomes of instruction in biology. Statements of this type tend to stress the development of critical thinking and problem solving abilities.

g. "Processes, skills, and techniques of inquiry" - Statements of this type are more functionally oriented than in f. They deal specifically with the techniques involved in employing the processes and methods of scientific problem solving.

h. "Research and creativity" - These statements are concerned with developing the capacity to do research. As such, they differ from f and g in their degree of specificity and for this reason are considered alone.

3. Attitude & interest objectives are those concerned with developing an appreciation of the contributions of and nature of the scientific enterprise, desirable attitudes involving science and scientists, and lasting professional avocational interests in students. Types of objectives are:

i. "Scientific habits or attitudes" - Statements typical of this type of objective convey a willingness upon the part of the individual to use a scientific method of solving problems in everyday affairs. Aspects of the objectives are concerned with the formation of correct habits of thinking involving the ability and inclination to recognize a problem, consider evidence, suspend judgement, change an opinion, and other general indications of "scientific mindedness".

j. "Appreciations" - These objectives carry an awareness and acceptance of the products and processes of science as they relate to life situations. They are on a more personal level than those involved with cultural implications and involve individual responses to the contributions of biology to daily living.

k. "Interest and hobby development" - Objectives of this type involve the development of non-career interests. Avocational pursuits such as insect collections or merely an interest in science reflected in a willingness to read about developments in biology are considered.

l. "Career development" - Objectives relating to pre-professional or vocational training, such as those calling for the development of future scientists and technicians are treated separately from those concerned with interest or hobby development (k). The level of interest is more clearly specified and careers are definitely stated as the end product.

m. "The nature of science and scientists" - Objectives of this type are concerned with the attainment of a realistic concept of the nature of science and scientists. Questions involving the workings and ethics or the scientific enterprise and those who make it function are central to this objective.

4. Cultural awareness objectives are thoses dealing with the interworkings of science and society or the cultural implications of science for society. Types of individual objectives are:

n. "Aesthetic aspects" - Objectives stressing the humanistic and creative aspects of science are considered to be of an aesthetic nature.

o. "Philosophical considerations" - Questions involving the ways in which science is influenced by the nature of society and the way science affects that society constitute philosophical objectives.

p. "Sociological implications" - Objectives involved with the effects of scientific innovations on society and their results are defined as sociological objectives.

q. "Economic aspects" - Awareness of how scientific advances influence economic development is considered to be a cultural awareness objective.

r. "Political implications" - Objectives dealing with governmental policy as a result of scientific activity and those involving public support of science are thought to be of a cultural nature and are so classified.

Analysis of Data

The information obtained was analyzed in an attempt to answer the following questions within and across subperiods:

1. What frequencies of citations were associated with each of the 18 objective types identified?

2. What major educational groups (see authorship) were involved in the writing of articles concerned with the objectives for teaching secondary school biology and did these groups agree or disagree in their outlook as determined by frequency rankings?

Definitions

1. Secondary education is that planned for pupils in grades nine through twelve.
2. Biology is the first biology course in secondary science.
3. Objectives are the stated outcomes, goals, or aims of instruction. The level of objective studied corresponds to what Krug (1) has called "statements for instructional fields or school subjects".
4. Authorship is an occupational categorization of the authors of articles obtained. Such authors were considered as representing secondary education, higher education, or miscellaneous backgrounds.

Results and/or Conclusions

Although yearly fluctuations existed with respect to both numbers of articles and statements concerned with the objectives for teaching secondary school biology that appeared in the selected periodicals of the 1918-1972 period, the number of distinct objective types remained constant. All eighteen of the objectives identified were found in the literature of all six subperiods. Most of the changes with respect to the frequency with which objectives appeared in the periodicals selected occurred during subperiods 4, 5, and 6. The following summaries refer to variations in the frequencies of the seven most prevalent objective types.

1. Although decreasing in frequency throughout all subperiods, statements relating to the study of "specific topics in biology" were most frequent throughout the entire 1918-1972 period (Figure 1).

2. Also decreasing in number following subperiod 2, statements stressing "interest and hobby development" were second in frequency throughout the fifty-five years studied (Figure 2).

3. Third in total frequency, statements calling for the development of "scientific methods of thinking" were most prevalent following the World War II years (Figure 3).

4. Statements relating to "the application of biology to daily life," fourth over-all, were most prevalent during the first four subperiods (Figure 4).

5. Concern for the "major facts, principles, concepts or fundamentals" of biology, as reflected by appropriate statements although never really pronounced during any one subperiod, were fifth in frequency over the entire study (Figure 5).

6. References to "processes, skills, and techniques of inquiry," sixth over-all, were most pronounced during subperiods 5 and 6 (Figure 6).

7. Objective statements stressing the "career development" aspects of biology teaching were most prevalent during subperiods 4 and 5 (Figure 7).

TABLE 1. -- CLASSIFICATION OF ARTICLES CONCERNED WITH THE OBJECTIVES OF SECONDARY SCHOOL BIOLOGY TEACHING FOUND IN PERIODICAL LITERATURE BY SUB-PERIOD AND AUTHORSHIP: 1918-1972.

Authorship	Subperiod 1	2	3	4	5	6
Secondary	72	90	131	102	136	120
Higher	78	56	63	73	110	197
Miscellaneous	35	30	30	31	41	59
TOTAL	183*	173*	222*	203*	275*	360*

* Totals do not agree due to multiple authorship

TABLE 2. --CLASSIFICATION OF STATEMENTS OF OBJECTIVES OF SECONDARY SCHOOL BIOLOGY TEACHING FOUND IN PERIODICAL LITERATURE BY SUBPERIOD AND AUTHORSHIP: 1918-1972.

Authorship	Subperiod 1	2	3	4	5	6
Secondary	105	150	201	147	286	272
Higher	112	95	104	122	194	396
Miscellaneous	52	45	47	55	63	114
TOTAL	265*	287*	350*	319*	512*	736*

* Totals do not agree due to multiple authorship

TABLE 3.--Percentage classification of statements of objectives of secondary school biology teaching found in periodical literature by subperiod, category, and authorship: 1918-1972

Authorship	Category	Subperiod 1	2	3	4	5	6
All Authors	Knowledge	44.9	42.8	41.7	35.1	29.2	20.5
	Process	10.1	15.3	12.5	17.5	25.7	24.8
	Attitude & Interest	26.4	29.6	30.8	32.6	36.5	32.8
	Cultural Awareness	18.4	12.1	14.8	14.7	8.3	21.7
	Total	99.8	99.8	99.8	99.9	99.7	99.8
Secondary	Knowledge	47.6	42.0	40.7	38.7	28.5	26.1
	Process	12.3	14.0	12.4	13.6	29.6	29.4
	Attitude & Interest	28.5	32.6	32.8	38.0	34.2	27.9
	Cultural Awareness	11.4	11.3	13.9	9.5	7.5	16.5
	Total	99.8	99.9	99.8	99.8	99.8	99.9
Higher	Knowledge	42.8	41.0	44.2	33.6	30.9	16.4
	Process	9.8	20.0	14.4	24.5	22.1	23.2
	Attitude & Interest	23.2	23.1	22.1	22.9	36.5	36.1
	Cultural Awareness	24.1	15.7	19.2	18.8	10.3	24.2
	Total	99.9	99.8	99.9	99.8	99.8	99.9
Miscellaneous	Knowledge	42.3	51.1	38.2	30.9	30.1	18.4
	Process	5.7	8.8	12.7	12.7	20.6	24.5
	Attitude & Interest	28.8	31.1	40.4	38.1	42.8	35.0
	Cultural Awareness	23.0	8.8	8.5	18.1	6.3	21.9
	Total	99.8	99.8	99.8	99.8	99.8	99.8

TABLE 4.--Percentage ranking of statements of objectives of secondary school biology teaching found in periodical literature by type, subperiod, and authorship: 1918-1972

Rank	Objective and Authorship	Subperiod 1	2	3	4	5	6
1.	Specific topics in biology						
	All authors	29.4	25.0	20.2	15.0	11.7	9.9
	Secondary	33.3	24.6	19.4	20.4	12.8	14.7
	Higher	27.6	20.0	20.1	13.9	11.3	6.3
	Miscellaneous	25.0	40.0	23.4	5.4	12.6	10.5
2.	Interest and hobby development						
	All authors	13.9	18.1	16.5	14.1	11.9	7.6
	Secondary	20.9	21.3	20.3	21.0	14.6	9.9
	Higher	8.9	11.5	7.6	7.3	6.7	4.2
	Miscellaneous	9.6	20.0	19.1	10.9	11.1	13.1
3.	Scientific methods of thinking						
	All authors	5.6	8.3	8.2	14.1	10.5	10.0
	Secondary	2.8	6.0	7.9	12.2	7.3	5.1
	Higher	8.0	14.7	10.5	18.0	15.4	13.6
	Miscellaneous	5.7	2.2	8.5	10.9	9.5	9.6
4.	The applications of biology to daily life						
	All authors	7.9	5.2	8.0	10.6	3.5	2.3
	Secondary	6.6	5.3	7.9	7.2	2.5	1.8
	Higher	8.0	7.3	9.6	13.1	5.1	2.5
	Miscellaneous	9.6	0.0	4.2	12.7	1.5	1.7
5.	Major facts, principles, concepts, or fundamentals						
	All authors	4.5	6.6	6.2	6.2	8.0	5.2
	Secondary	2.8	6.6	7.4	8.8	7.8	5.5
	Higher	5.3	7.3	4.8	3.2	7.2	4.5
	Miscellaneous	5.7	4.4	4.2	7.2	9.5	6.1

TABLE 4.--Continued

Rank	Objective and Authorship	Subperiod 1	2	3	4	5	6
6.	Process, skills, and techniques of inquiry						
	All authors	4.1	6.2	3.7	3.1	9.7	9.9
	Secondary	8.5	6.6	3.4	1.3	14.2	16.9
	Higher	1.7	5.2	3.8	5.7	4.6	6.3
	Miscellaneous	0.0	6.6	4.2	1.8	4.7	8.7
7.	Career development						
	All authors	3.0	2.7	5.1	7.5	10.1	6.2
	Secondary	1.9	3.3	2.4	8.1	7.8	7.7
	Higher	2.6	1.0	5.7	4.9	11.8	5.5
	Miscellaneous	5.7	4.4	14.8	10.9	15.8	5.2
8.	Scientific habits or attitudes						
	All authors	2.6	4.8	3.4	4.3	5.4	7.6
	Secondary	2.8	3.3	2.9	4.7	4.2	4.4
	Higher	1.7	8.4	3.8	4.9	7.2	9.5
	Miscellaneous	3.8	2.2	4.2	1.8	4.7	9.6
9.	The nature of science and scientists						
	All authors	4.5	2.0	3.1	3.7	6.2	7.0
	Secondary	2.8	2.6	3.4	1.3	5.0	1.8
	Higher	6.2	1.0	2.8	3.2	7.2	10.8
	Miscellaneous	5.7	2.2	2.1	10.9	9.5	5.2
10.	Philosophical considerations						
	All authors	4.1	2.7	4.2	3.1	2.9	5.9
	Secondary	3.8	3.3	2.4	2.0	3.5	3.6
	Higher	5.3	2.1	8.6	4.0	2.0	7.8
	Miscellaneous	1.9	2.2	2.1	3.6	1.5	4.3

TABLE 4.--Continued

Rank	Objective and Authorship	Subperiod 1	2	3	4	5	6
11.	Sociological implications						
	All authors	5.6	2.0	1.4	4.0	2.7	6.1
	Secondary	4.7	1.3	0.9	3.4	2.8	6.2
	Higher	6.2	4.2	2.8	3.2	2.5	5.0
	Miscellaneous	9.6	2.2	0.0	7.2	3.1	8.7
12.	Political implications						
	All authors	2.2	2.0	4.8	5.0	2.1	5.4
	Secondary	1.9	2.0	5.4	1.3	0.7	4.0
	Higher	1.7	2.1	2.8	8.1	4.6	7.0
	Miscellaneous	3.8	2.2	6.3	7.2	1.5	1.7
13.	Study skills						
	All authors	1.5	2.7	3.1	2.1	4.8	2.5
	Secondary	3.8	2.6	2.9	2.0	4.2	4.0
	Higher	0.0	2.1	2.8	1.6	5.6	2.2
	Miscellaneous	0.0	4.4	4.2	3.6	4.7	0.0
14.	Appreciations						
	All authors	2.2	1.8	2.5	2.8	2.7	4.4
	Secondary	0.0	2.2	3.4	2.7	2.5	4.0
	Higher	3.5	1.0	1.9	2.4	3.6	5.8
	Miscellaneous	3.8	2.2	0.0	3.6	1.5	1.7
15.	Aesthetic aspects						
	All authors	4.5	2.4	2.5	1.8	0.1	3.1
	Secondary	0.0	2.0	3.4	2.7	0.3	1.4
	Higher	8.0	3.1	1.9	1.6	0.0	3.0
	Miscellaneous	5.7	2.2	0.0	0.0	0.0	7.0

TABLE 4.--Continued

Rank	Objective and Authorship	Subperiod 1	2	3	4	5	6
16.	Research and creativity						
	All authors	0.3	0.6	0.5	0.3	5.4	4.8
	Secondary	0.9	1.3	0.9	0.0	7.8	7.3
	Higher	0.0	0.0	0.0	0.8	2.0	3.2
	Miscellaneous	0.0	0.0	0.0	0.0	6.3	6.1
17.	A fund of useful information						
	All authors	1.5	3.1	4.0	0.9	1.1	0.4
	Secondary	0.9	2.6	2.9	0.0	1.0	0.0
	Higher	1.7	4.2	6.7	1.6	1.5	0.7
	Miscellaneous	1.9	2.2	2.1	1.8	1.5	0.0
18.	Economic aspects						
	All authors	1.8	2.7	1.7	0.6	0.3	1.0
	Secondary	0.9	2.6	1.4	0.0	0.0	1.1
	Higher	2.6	4.2	2.8	1.6	1.0	1.2
	Miscellaneous	1.9	0.0	0.0	0.0	0.0	0.0

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